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GOVERNMENT RESEARCH AND DEVELOPMENT DIGEST

VOL. 2, NO 6



**NORTHROP SNARK**

In this issue . . .

**U.S. MISSILES--QUICK REFERENCE**

# data

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# briefings!

## TEST PILOT MOTIVATION SURVEY:

What makes them want to fly the new supersonic jets? A sample of 21 test pilots at the Flight Test Center at Edwards AFB, Calif., showed some interesting results. Number one reason for selection of test piloting duty was opportunity for diversified flying. Following that were: desire to explore and conquer unknown areas, prestige-recognition, and a good stepping stone to a civilian job. The "thrill" of it was placed in last position.

Eighteen of the pilots stated that more technical information and more formal schooling, especially in engineering, would have better qualified them for their jobs. In general, the test pilots were cautious, careful individuals with self-confidence in their flying ability and the feeling that they knew their aircrafts well.

Seventeen of the men indicated they were well satisfied with their assignments and planned to continue test flying.

## ARMY WILL GET NEW ANTI-TANK MISSILE:

The Army is now developing a new anti-tank missile to replace the DART. It will be faster and have smaller guidance fins. The DART, present anti-tank missile, is too big and slow. It can be shot down by rapid interdiction fire.

## KIRKPATRICK TO BE NEW NAVY CHIEF OF INFORMATION:

R/Adm. Charles C. Kirkpatrick, USN, will become the new Chief of Information for Navy in November, presently is Chief of Staff to the Commander, U. S. Taiwan Defense Command. Other flag officer assignments include R/Adm. Walter G. Schindler, now Commander, Naval Forces, Germany, who will become Commandant of Eighth Naval District, New Orleans, in July. R/Adm. Ulysses S. Sharp, Jr., Commander, Cruiser Division THREE, will report to Office of Naval Operations for duty in August.

## DOES PANAMA WANT CONTROL OF CANAL?

Some observers say that by 1960 Panama will be seeking control of the Canal. Much speculation bounced around during Carib-Ex, as a mock airborne-amphibious attack was held on isthmus. Latin Americans in general seem to feel U.S. build-up of defense measures in zone would be wiser than depending on stateside strength. Negotiations with Panama for NIKE sites in 1956 bogged down. No NIKE there yet.

## MESSAGE TO READERS

Author of the current best-seller, "Air Force" and other books concerned with air power, Martin Caidin presents in this issue a reflection on current U.S. air strength.

### THE BIG UMBRELLA

Less than one year ago critical elements of the press and qualified military sources heatedly assailed both USAF and US Army for the admitted inability to defend prime targets against the USSR's high-flying BISON bomber. Unhappily such criticism was justified; the nation's prime targets lay naked to a BISON assault. With an altitude capability (according to best USAF and CIA reports) exceeding 53,000 feet, BISON could overfly our best fighter planes and point defense missiles.

Not one USAF fighter then in operational service could fight and fly at the altitude where BISON would make its target run with a hydrogen bomb. The F-94C, F-86D and F-89D were unable to reach BISON's target-run height. Armed with FALCON missiles fired from a zoom climb, the F-89H offered the only (and a scant) defense hope, and there were few enough H models and FALCON missiles around at the time.

About one year ago the F-101 was still going through its teething troubles, the F102A was just beginning to roll off the production lines and there were available but a handful of the spectacular F-104A fighters. F-100 lacked all-weather capability. Army's vaunted NIKE-AJAX, limited to ten-miles height, was unable to even annoy the high BISON.

A year has gone by and again the calculated risk has paid off. Today there is not a single aerial weapon in the USSR locker which can overfly the current defensive vehicles of the USAF, USA or USN. USAF has large numbers of rocket and FALCON-armed F-102 fighters. It is rushing into service the first F-104A units, truly a marvelous machine which has reached Mach 2.9 in level flight and in a zoom climb has shot to more than 80,000 feet. The Navy's 1200 mph fighters, the F11F and F8U, along with the powerful F5D combine with carrier mobility to form a powerful defensive arsenal. Add missiles like TERRIER, SIDEWINDER, DINGDONG, FALCON, SPARROW I and III, NIKE-HERCULES and the sensational BOMARC and the firepower barrier across the high sky of our nation reaches unprecedented heights and effectiveness. These operational, or soon-to-be operational weapons, joined with our massive radar lines, with picket planes and ships, have given us the aerial defensive capability which we've needed desperately for so long a time.

MARTIN CAIDIN



May 21, 1954 202-1000

# Department of Defense Directive

**SUBJECT: Funding of Procurement Contracts and  
Interdepartmental Requests and Orders for Procurement**

## **I. PURPOSE**

The purpose of this directive is to insure orderly execution of the procurement programs of the Department of Defense within the appropriations and funds available.

## **II. AUTHORITY**

The National Security Act of 1947, as amended.

## **III. SCOPE**

The provisions of this directive are applicable to all organizational subdivisions of the Department of Defense to which appropriations or funds for procurement are made available.

## **IV. POLICY**

**A.** No procurement of materiel, equipment, or work or services in connection therewith shall be directed or authorized unless adequate appropriations and funds are available under the applicable Department of Defense "Financial Plan" (1) for obligation, (2) set aside in the form of a commitment, or (3) set aside in a reserve account in an aggregate amount sufficient (a) to complete the procurement of a specified number of end items (including, where applicable, initial spares and spare parts) usable either in service units or for test and evaluation, or (b) when specifically provided for under a current apportionment of funds, to complete a pre-production program or procure components in advance of the fiscal year in which the related programmed end item is directed to be procured. Any procurement directed or authorized and not yet wholly consummated will be rescinded or modified to conform to the policy stated herein.

**B.** No contract or military interdepartmental procurement request or other order for procurement of materiel, equipment, or work or services in connection therewith shall be executed (1) unless the officer directing or authorizing the procurement has determined in writing that such procurement is a part of a program directed or authorized under A. above and (2) unless funds are available for obligation by the officer executing the contract or military interdepartmental order or other order in an amount sufficient to procure the specified number of items, components, or the specified work and services.

C. When letter contracts and letters of intent are utilized to effect procurement for materiel, equipment, work or services in connection therewith, any amount committed but not yet obligated under such arrangements shall be regarded as a charge against the obligational authority apportioned under the financial plan for the current fiscal year, but any such amount will not be charged against the limits of the obligational authority otherwise established under the Department of Defense "Financial Plan" for the succeeding fiscal year.

D. Immediate steps will be taken to modify any contract, military interdepartmental procurement request or other order for procurement to conform with this policy. If for any reason there should be insufficient obligational authority available in fiscal year 1957 to conform all outstanding transactions to this policy, such amounts as may be necessary to do so will be a first charge against obligational authority to become available under the financial plan for fiscal year 1958.

E. For the purposes of this directive, all estimates shall be based upon the latest available firm prices. In the event firm prices are not available the best current working estimate of cost shall be used and adjustments will be made promptly when evidence of significant variation in costs becomes available.

#### V. EXCEPTIONS

The following procurements are excepted from the provisions of this directive.

1. Procurements from Research and Development appropriations.
2. Such procurements as are specifically excepted upon approval of the Secretary of Defense.

#### VI. IMPLEMENTATION

Copies of the military department regulations or instructions in implementation of this directive shall be submitted to this office for approval within ten days.



Secretary of Defense

May 21, 1957  
NUMBER 7200.4

### 263. EARTH WILL AGE FASTER THAN SPACEMEN - STUHLINGER:

Want to stay young? Then go out into space at the speed of light. Time will be relative, says Dr. Ernst Stuhlinger, chief of the Research Section, Guidance Control Branch, Redstone Arsenal. If you take a trip through the galaxy and zoom along for 40 years at the speed of light, you would return to Earth 40 years older, but everything on Earth would have aged a few million. Speaking at the Department of Interior Auditorium the evening of May 23, Stuhlinger declared photon (light) powered spaceships a possibility, with trips to the moon in three and one-half hours (it takes time to build up speed on the short runs) and maybe two days to a planet.

///Stuhlinger/

### 264. BOMARC IN PRODUCTION BUT SOME RELUCTANCE:

Whether BOMARC is complete answer to pilotless intercepting of bomber carrying H-bomb 200 to 250 miles away is questioned on Hill by some Army scientists. However, first production order for Boeing missile was announced in mid-May, \$7,109,195. BOMARC is reported able to carry nuclear warhead, according to Pentagon release. Secrecy on design was lifted on Armed Forces Day when Andrews Field displayed BOMARC, NIKE HERCULES, RASCAL and LACROSSE. The BOMARC has speed of over 1600 mph, can reach about 250 miles in all weathers and can operate at an altitude better than 60,000 feet. It is 47 feet long, has 18-foot wingspan, and weighs 15,000 pounds. Rocket-launched, it cruises by ramjet.

///Pentagon OPI 0516/

### 265. B-52 MAY BE LAST OF SUBSONIC BOMBERS:

Richard E. Horner, Acting Assistant Secretary for Air (R&D), has stated that the B-52 (and its improvement) is very nearly the best subsonic bomber we can see in present-day technology, but he says that it is "... probably the last subsonic strategic bomber that we will design." The follow-up or improved B-52 will very probably use an exotic fuel with higher heat content than JP-4. There are 18,000 BTUs in pound of JP-4 kerosene-base fuel.

///Appropriations Hearings/

### 266. NEW LONG-RANGE INTERCEPTOR; NORTH AMERICAN:

Development of a new long-range manned interceptor airplane has begun with USAF announcement May 16 that a design study contract has been awarded North American Aviation, Inc., with the Los Angeles division on weapons. No details of the aircraft.

///USAF 0516/



267. FOUR ROTOR HELICOPTER shown at right is the QUADROTOR, built by Convertawing, Inc., of Amityville, L. I. The new craft is of interest to the Army and the manufacturer was awarded a research and development contract in mid-May for \$89,000.

The prototype has four rotors turned by two engines. The one-man machine is a test-bed for a large heavyweight cargo hauler.

///Ft. Eustis, Va. photo release 0514 503187/

268. REDESIGNED SEAMASTER SET FOR SPRING-1958 DELIVERY.

Spring 1958 delivery by Martin is scheduled for redesigned six-jet SEAMASTER bomber. First two experimental models crashed, one due to control systems malfunction and other due to unexpected forces on horizontal tail surfaces which overpowered hydraulic control system at top speeds, causing plane to make tight inside loop. SEAMASTER was designed primarily as mine layer, has been highly praised by Adm. A. A. Burke in appropriations hearings. //composite news releases/

## 269. HELICOPTERS FOR MARINES:

Each Marine Corps wing will have a 24-helicopter observation squadron, under reorganization. Composite photographic squadrons are increased from 18 to 20 planes. Helicopters of MC are seen as key to landings in atomic war. More space in machines needed, although new 26-man helicopter, Sikorsky HR2S, now being readied, may meet the demand. Takeoffs will be made from carriers such as THETIS BAY. The Marines hope for appropriation for new carrier to hold 45 'copters and a battalion landing team; want 12 ultimately. //USMC Info./

270. NEW DUAL-PURPOSE PARACHUTE FOR AIRCREWS:

By combining two types of personnel parachutes, air crews now have material that can be used for both signaling and camouflage if the need arises. In the past parachute canopies were made of either all signal or all camouflage cloth. The new canopies are being made of one half signal cloth, and one half camouflaged material. With the current possibility of bail-outs in either isolated regions of the world or deep in enemy territory, the combination chute will give the crewman material for hiding or signaling. //ARDC 0520 155/

271. FIRST VIEWS OF T-38, new lightweight jet trainer by Northrup for USAF. This trainer has capabilities of fighters. Instructor is behind and higher than student. A raised seat in the rear cockpit enables instructor to check student movement and reactions. T-38 is high performance aircraft throughout. It has "coke bottle" or area rule fuselage configuration. Northrup claims low maintenance and ability to operate from short runways.



///Northrup A/C 0522/

#### 272. TRANQUILIZERS OUT FOR ARMY PILOTS:

Following other services, Army orders its pilots not to fly if they are using tranquilizing drugs. Writing on "Tranquilizers vs Flying Safety," Capt. Robert B. Muffly, MC USA, details reactions after using various tranquilizer drugs and tells why they are incompatible with flying safety. "They interfere with the individual's ability to react. This is desirable to calm overactive persons but is not desirable where the ability to react is of paramount importance as it is in the aviation environment."

///Army Aviation Digest/

#### 273. MARTIN SUBCONTRACTS SATELLITE COASTING COMPUTER:

Glenn L. Martin, prime contractor on VANGUARD, subcontracted coasting time computer to Air Electronics, Inc. of Teterboro, N. J. The device has had exhaustive tests, will determine when third stage of the launching vehicle will be fired, injecting satellite into orbit.

///Martin 0522/

#### 274. HUMAN REACTIONS TOO SLOW FOR SPACE SATELLITES:

If men venture into space aboard a satellite, they cannot be expected to participate in the guidance or control of the vehicle which will travel 17,000 mph. This opinion was voiced by Dr. George E. Long, a former Air Force technician and now head of Douglas Aircraft's human factors group at Long Beach, Calif. Man's reaction time, Long said, even under the most favorable conditions, may vary from one-fifth to one-half of a second - time enough for a satellite to travel from one to two and one-half miles. "When we consider that his reaction to the more complex situations would vary far more widely, we can see control and guidance must be automatic."      ///Long - Douglas 0522/

## COMMUNICATIONS

### 275. BACKPACK RADIO RELAY SET FOR MARINES:

A radio communications relay set that a man can carry on his back to almost inaccessible battlefield locations is being produced for the Marines by Raytheon. It ties in with new Marine doctrine of helicopter assault. Previous radio relays had to be carried by vehicle thus barring use in restricted areas. Range of new set is 10 miles, reaches 40 miles if linked.

///Pentagon OPI 0521/

### 276. INFRARED GUIDANCE VIES WITH RADAR IN SOME FIELDS:

Infrared promises far more than radar in future detection missions involving jets because the attraction is heat, as from fiery exhausts, rather than reflection from bulk, as is radar; also it works faster than radar. Aviation Week sees replacement of radar in decade in some fields of guidance and target-detection. Navy rather silent on SIDEWINDER's infrared guidance and so is Air Force on DINGDONG. However, Naval ordnance developer, Dr. William B. McLean, and his associates point out some advantages of infrared guidance: it is cheap, it is not subject to jamming, it is more compact than radar, it defines object more accurately. Disadvantages: it is not selective - heat-seeking missiles home on any heat; no range-finding; unreliable in moisture but good above cloudlevel, air-to-air in daylight. For some jobs it will never replace radar, but looks like good supplement.

///Aviation Week and Nav Inst Proceedings/

### 277. MAINE TO HAVE NAVY'S TOP VLF STATION:

By 1961 world's most powerful and effective Very Low Frequency (VLF) radio station will be operating in Washington County, Maine. VLF stations are used by Navy for shore-to-ship broadcasts, operating at around 15 to 20 kcs. Maine transmitter may be rated as high as 2000 kw. About 3000 acres required for buildings. Traditional flat-top antenna array will be abandoned. Special antenna will be used for this installation. It will be cross between new German type and Annapolis VLF.

///Nav Com Bulletin 06/

### 278. NAVY BUYS UNIVAC-LARC FOR REACTOR PROBLEMS:

The Navy's Bureau of Ships has announced the acquisition of the \$3,500,000 UNIVAC-LARC electronic digital computer by Remington Rand. Able to do more than 100,000 multiplications a second, it will be installed at the David Taylor Model Basin in D. C. ///Pent. OPI 0516/

## ELECTRONICS



279. PRECISION TELESCOPE at Naval Research Lab is 10-foot radio 'scope capable of operating at wavelengths shorter than one centimeter and will be used for studies of radiation from the earth's cloud cover. Usually the radiation observed is heat extended to radio wavelengths

and in audible form sounds like a hissing noise. Its intensity will be studied. Also, sunspots, flares and radiation from farther objects in the universe will be observed. Nearer home, the radio telescope will be useful for the study of weather phenomena, cloud electrification and thunderstorm processes. It fills gap between radio and optical astronomy and is the only instrument of its kind. //ONR Research Reviews/

### 280. NOISE-RECORDING RADIO STATIONS:

Sixteen radio noise-recording stations throughout the world will provide the basis for studies on radio propagation and meterology, as well as supply information helpful in assigning frequencies to stations. Set up by the National Bureau of Standards in conjunction with activities of the International Geophysical Year program, the stations will supply data useful to commercial and military radio users who must know which frequencies are best for use at a given time and place. The lab at Boulder, Colo. will collate all reports and issue forecasts of the amount of unwanted noise that will interfere with radio communications, thus enabling the sender to tell the minimum power that can be used to get the message to the receiver in spite of natural-noise competition.

///NBS 2116/

### 281. NAVY RECEIVES IBM CALCULATOR FOR SATELLITE ORBIT:

The VANGUARD computing center at 615 Pennsylvania Ave., NW in Washington has received the IBM 704 electronic data processing machine which will be used to calculate and predict the orbit of the scientific earth satellite. Dr. John P. Hagen, Project Director for VANGUARD at NRL, said the computer will be used to produce a "celestial timetable" of the satellite's orbit as it swings about the earth at speeds upwards of 18,000 mph some 200 to perhaps 1500 miles above the earth's surface. He further stated, "The satellite's orbit will not be a true circle above the earth but will be elliptical, and due to the earth's atmosphere and shape the orbit will change." The high-speed computing center will sense these changes. //Pentagon OPI 0517 494/

## CONSTRUCTION

282. PATRICK AFB AND CONVAIR CAUSE COCOA, FLA. BOOM:

Eighty miles south of Daytona Beach near Patrick AFB is Cocoa, Florida's latest boom town. Navy's guided missile test center draws too many jobholders to too few houses. Cement block stuccoed housing badly needed to face up to Florida's termites. Convair, awake to need, has purchased waterfront property for its employees' housing, hopes to accommodate 350 families. Fairchild has similar plans. On-base military housing said to be adequate. //DATA composite/

283. ANTARCTIC CONSTRUCTION:

With IGY (International Geophysical Year) studies due to start on July 1, Navy Civil Engineering Corps officers and Seabees profit from kinks in DEEP FREEZE I and II operations and plan further Antarctic construction at the seven U.S. bases for benefit of resident scientists, who, in turn, will aid world through programs in auroral observations, geomagnetism, ionospheric physics, meteorology, seismology, cosmic ray observations and glaciology. Humidity proves serious problem in quarter construction - less than five percent. Several schemes tried for increasing. Coldest weather Seabees experienced was 79 below, winds over 60 knots. //CEC Bulletin 05-4/

#### 284. NEW FACILITIES AT NOL:

Construction has begun on expansion of hyperballistics research facilities at Silver Spring, Md. Naval Ordnance Lab will study problems of high speed flight. NOL has wind tunnel facilities now, new lab will supplement.

The White Oak plant of the Naval Ordnance Laboratory, located near Silver Spring, just north of Washington, D. C., is one of the most modern and best equipped research and development facilities in the world. Construction of the plant was substantially complete in 1949, although new buildings and facilities are added as the need arises. The station includes over 160 buildings located on an 876-acre tract. It represents a capital investment of approximately 28 million dollars in property, plant and structures, plus 20 million dollars in equipment. Intangibles in special equipment add many more millions. //NOL/

## 285. MARTIN ATOMIC FACILITY:

Completion by June 1 is seen for the Glenn L. Martin nuclear experiment facility at Middle River, Md. //Martin A/C/

## 286. WHO IS BUILDING ATOMIC PLANE?

Nuclear power studies were discussed this way in hearings before House Appropriations Committee on 1958 budget:

Mr. FORD (R-Mich.): In your nuclear powered project are you aiming to produce a military plane or a plane for other purposes?

Mr. HORNER (Acting Asst. Secy. for Air-R&D) Our requirement for a nuclear propelled airplane is for a weapon.

FORD: Is anybody else in the government or otherwise, to your knowledge, doing work on a nuclear powered plane for nonmilitary purposes?

HORNER: I have a very limited knowledge of the amount of work that is being done by the Navy. I understand that there is some work going on in the Navy. It is for military purposes, however.

FORD: How about the National Aeronautics --

HORNER: I know of no other aeronautics nuclear propulsion program in the government.

Mr. FLOOD (D-Penn.): Will the gentleman yield?

MR. FLOOD (Continued). Will the gentleman yield?  
FORD: Yes.

FLOOD: (to Horner) What about outside the government?  
HORNER: It is entirely possible there are studies going on in certain industrial areas. //Appropriation Hrgs.

282 ATOMIC BLAME POSSIBLE IN THREE YEARS - LOCKHEED

The Lockheed Aircraft Corp. has announced it could build atomic plane in three years if given green light, then would test for year. Lockheed Georgia division wants to set up advanced lab for USAF on this.

///New York Herald Tribune 0516/

## 288. WHY THE ATOMIC AIRPLANE?

The material following is a direct quote from Newsweek Magazine, June 4, 1956:

"Just what could a nuclear aircraft do that would make it such a deadly weapon, and what makes its immediate development so important? Range and elusiveness are the principal answers- the qualities now available in the atomic submarine, but with the vast dimension of the sky added. These qualities could render the U.S. military position almost unassailable.

"Consuming less than a pound of enriched uranium for every 100,000 miles of flight, A-planes could make obsolete the nightmarish logistic problems of refueling." //Newsweek 0604-56 pg.55/

///Newsweek 0604-56 pg.55//

## LOGISTICS

### 289. GLASS OF HIGH STRENGTH MAY REPLACE METAL:

A family of new materials stronger than steel, lighter than aluminum with high elasticity, non-rustable and great heat resistance were unveiled to a gathering of nearly 200 newspaper and magazine representatives at the Corning Glass Works, Corning, N. Y.

The new materials are called pyrocerams. They are not strictly glass although the basic ingredient is glass. Small amounts of so-called "nucleating materials" are added to the glass changing the normal crystalline structure. Pyrocerams have been called "solid liquids" since atoms and molecules in the resulting substance are not arranged in any orderly pattern. The materials thus formed are said to be harder than high carbon steel and nine times stronger than plate glass. A guided missile nose made of the new material will withstand a temperature of 1300 degrees Centigrade without deteriorating.

Corning officials say that possibilities of the new materials are unlimited.

///Corning Glass Works 0522/

### 290. NAVY DIVERTING MORE FUNCTIONS TO INDUSTRY:

Navy is diverting more functions to private industry and is said to be contracting to the maximum for the following: telephone systems, cement mixing plants, wood preservation operations, office equipment repair shops, tree and garden nurseries, automotive equipment repair shops, aluminum sweating operations, scrap metal bailing operations, coffee roasting, sawmill operations, ice cream making, bakeries, laundries and dry cleaning, photographic equipment, ice plants and power plants.

Also, in three areas the contracting by private industry to the Navy is now expanding and indicating a trend. Formerly all ship repair was done in Navy yards; now about 25 percent dollarwise is by private contractors. Refueling at 17 airfields is by private contractors. And maintenance work on some heavy transports is now by private contractor. Other fields may open soon.

///Appropriations Hearings/

### 291. SHOCK SUSTAINED BY SHIPPING CONTAINERS MEASURED:

The Air Force has a new machine called the Impact-o-graph. It costs under \$200 and saves many times its original cost by providing knowledge about better ways to package items, thus helping to eliminate the waste due to broken containers. The machine was developed for the Air Research and Development Command and records shock continuously as package is handled in units of inches of drop height.///ARDC 0517/

## MATERIALS

### 292. ARMY R&D CONTRACTORS GUIDE AVAILABLE:

Prepared by the Office of Chief Research and Development, a new 36-page sepia-toned booklet is available to manufacturers, service companies, contractors' agents and others who might be interested in the procedures employed by the Department of the Army in their contract awards in research and development.

The booklet is divided into a general information section, a technical services directory and a special activities section. A foreword by Lt. Gen. James M. Gavin, Army R&D chief, expresses the desire to enlist "...the inventive genius of American science and industry" to help serve the Army's needs and the needs of the American people.

The booklet is a good reference guide for contractors as it lists how to prepare proposals, where to submit them and who buys what.

It is available on request at no charge. Write: Technical Liaison Office D, Chief Research and Development, Department of the Army, Washington 25, D. C. Ask for Army R&D Contractors Guide offered in June issue of DATA.

///Army R&D/

### 293. PLASTIC TOOL AND DIE FIELD OPPORTUNITIES NOTED:

According to the Small Business Administration, favorable opportunities now exist for small foundries and machine shops to enter the plastic tool and die field. Nearly 14 million pounds of plastics were consumed in tooling in 1956 as against 5 million in 1954. For more information contact local SBA rep or write Small Business Administration, Washington 25, D. C.

///SBA/

### 294. AIR FORCE SEEKS TO LOWER FIRE LOSSES:

Structure fires throughout Air Force build concern, cause casualties and jeopardize missions. Losses in fiscal 1957 top 1956 by nearly 200 percent, with \$14 million costs for about three-fourths of fiscal year. Avoidable fires blamed on cigarettes, electrical circuits, failure to turn off or disconnect appliances, frayed or unsafe cords and wires and negligence in working around hazardous materials. Industry development of safer equipment in this area is desired.

///TIG Brief 05-16/

### 295. NORTH AMERICAN WORKS ON WINDSHIELD RAIN REMOVER:

Air Force F-100s fly through showers created by tankers releasing 3000 gallons of water from trailing hose and perforated cone at the North American aircraft company. Object: better visibility. ///NAA/

# FROM V-R... Products

Exclusive elevator type toolholders and cemented carbide inserts — throw-away and  $1\frac{1}{2}$ " lengths.



V-R face mill cutters with square throw-away cemented carbide inserts.

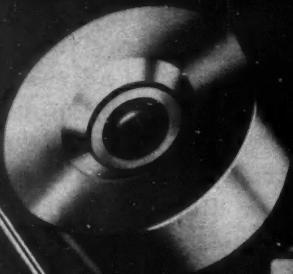
Cemented carbides — tipped and solid tools — standard and custom blanks.

Carbide tipped mining bits and percussion rock bits for mining and construction industries.

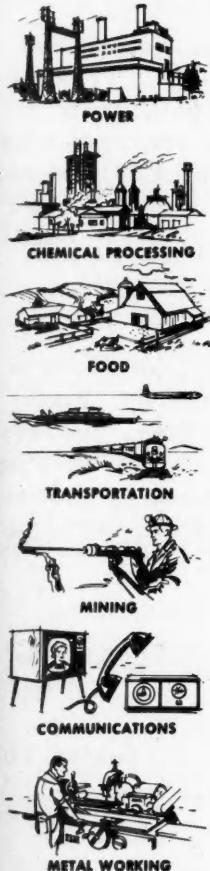


Exclusive V-R Tantung cast alloy type tools, solid tool bits and cut-off blades.

Carbide drawing dies — rough — round, square, hexagon and rectangular.



# ector Industrial Progress



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**NEW V-R FACE MILL CUTTER MACHINES TITANIUM AT LOWER COST.** V-R throw-away insert type face mill cutters, using V-R carbides, replaced old style brazed tipped cutters for machining titanium aircraft parts. Result—\$208 reduction in tool cost and downtime while removing 1186 cu. in. of material.

**V-R TANTUNG TOOLS DOUBLE PRODUCTION.** Excessive tool changes were experienced using high speed steel cutting tools on old style automatic lathes turning Nitrally. A change to Tantung tools permitted increasing surface speed from 100 fpm to 200 fpm. Production is now double that previously obtained.

**V-R TOOLHOLDERS INCREASE PRODUCTION 25%.** Grinding of carbide tipped tools was eliminated by changing to V-R toolholders and throw-away carbide inserts for turning operations. Lathe production has been increased 20% to 25%. Downtime is now negligible. Regrinding has been eliminated.

**V-R ROOF DRILL OUTPERFORMS OTHER DRILL 32 TO 1.** In difficult drilling of sandstone for roof bolting in a coal mine, a V-R heavy duty roof drill produced 32 holes before grinding, while bits previously used failed after a single hole.

Costs are a critical factor in industry. Progress depends on cost reduction and greater output per manhour. Use of V-R carbide and Tantung cast alloy products make appreciable contributions to greater efficiency. For complete data, call your local V-R Representative or Distributor, or fill in and mail the coupon today.

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DATA

## MEDICAL NEWS

### 296. GLOW, LITTLE GERM, GLOW:

A new fast means of identifying disease-producing germs has been developed by the Armed Forces Institute of Pathology. Treatment of patients can be speeded up based on identification of pathogenic organisms which can be made fluorescent and then can be observed with ultra-violet microscope. Each germ will glow. Conventional methods of identification usually take 24 hours or more. This method - under 30 minutes.

///AFIP 0523/

### 297. NUTRITION PROBLEM SURVEYS AID ALLIES:

U. S. allies having nutrition problems may now ask for surveys under MDAP. Six requests have already come to that agency. Sixth request came from Libya and team will start survey in June. Surveys for Iran, Pakistan, Republic of Korea, Philippines and Turkey have been completed. Essential lab equipment and supplies furnished by U.S. but turned over to host government at close of survey. ///Pent. OPI 0516/

### 298. PENSACOLA HAS NEW AVIATION MED CENTER:

Existing facilities at NAS Pensacola have been redesignated to form a new Aviation Medical Center. This will extend scope and improve quality of various aspects of aviation medicine, says R/Adm. Bartholomew W. Hogan, Surgeon General of Navy.      ///BuMed TIO/

### 299. BIOLOGICAL LAB ON WHEELS:

A mobile biological laboratory now permits the Chemical Corps to take off for a field testing trip on a moment's notice. Rigid frame van body, mounted on semi-trailer, provides facilities for performing biological, chemical, physical and sanitary engineering studies, carries own water and electricity supply. Lab developed at Fort Belvoir, Va.

///Ft. Belvoir ERDL 0517/

### 300. DOCTOR DRAFT OUT IN NEXT FISCAL YEAR:

Dr. Frank B. Berry, assistant defense secretary for health and medicine, announced that the Defense Department plans no doctor's draft in fiscal year 1958 (beginning July 1). Dr. Berry pointed out that the services are getting doctors from medical school graduates who want to complete military service before establishing a civilian practice. Also, more doctors now staying in service. ///Berry press conf/

# ORDNANCE

301.

## FACT SHEET ON GUIDED MISSILES

Given below is the complete fact sheet of American guided missiles as released by the Department of Defense on May 20, 1957.

The Army has announced the following guided missiles of which the first two are operational:

NIKE-AJAX.....	Surface-to-Air
CORPORAL.....	Surface-to-Surface
REDSTONE.....	Surface-to-Surface
JUPITER.....	Surface-to-Surface
LACROSSE.....	Surface-to-Surface
DART.....	Surface-to-Surface
NIKE-HERCULES.....	Surface-to-Air

The Navy has announced that the first five of the following weapons are operational:

SIDEWINDER.....	Air-to-Air
PETREL.....	Air-to-Surface
REGULUS.....	Surface-to-Air
TERRIER.....	Surface-to-Air
SPARROW I.....	Air-to-Air
SPARROW II.....	Air-to-Air
SPARROW III.....	Air-to-Air
TALOS.....	Surface-to-Air
TARTAR.....	Surface-to-Air
POLARIS IRBM.....	Surface-to-Surface

The Air Force has announced that the first two of the following are operational:

MATADOR.....	Surface-to-Surface
FALCON.....	Air-to-Air
SNARK.....	Surface-to-Surface
NAVAHO.....	Surface-to-Surface
RASCAL.....	Air-to-Surface
BOMARC.....	Surface-to-Air
ATLAS ICBM.....	Surface-to-Surface
TITAN ICBM.....	Surface-to-Surface
THOR IRBM.....	Surface-to-Surface

(More)

ARMY

NIKE-AJAX, named NIKE after the Greek goddess of victory, is the Army's first supersonic antiaircraft guided missile designed to intercept and destroy the enemy target regardless of evasive action. NIKE guided missile units are now deployed around vital industrial, highly populated and strategic areas of the United States. NIKE-AJAX is a missile about 20 feet long and about one foot in diameter, with two sets of fins for guidance and steering. It is boosted to supersonic velocity by a solid-propellant booster and maintained by a liquid sustainer motor. The missile and booster weigh more than one ton. Speed, range, altitude and lethality of NIKE-AJAX can meet an attack from any direction and its kill potential has far exceeded expectations. There are 12 launchers in each NIKE battery, each battery being operated by approximately 100 officers and men. Personnel are trained at the Anti-aircraft and Guided Missile School, Fort Bliss, Texas, and the Ordnance Guided Missile School, Huntsville, Alabama.

CORPORAL, equipped with either an atomic or conventional type warhead, is capable of engaging tactical targets at ranges of over 75 miles. The weapon gives the field commander great firepower on the battlefield and enables him to strike selected targets deep in enemy rear areas. CORPORAL follows a ballistic trajectory during most of its flight to the target. Weather and visibility conditions place no restriction on the use of the weapon. The missile uses a liquid propellant rocket motor, and travels through space at several times the speed of sound. A CORPORAL battalion has 250 men. Each battalion has two batteries -- a firing battery and a headquarters service battery. There are two operational launchers to a battalion. CORPORAL battalions have been deployed to Europe.

REDSTONE is the largest surface-to-surface ballistic guided missile successfully fired in this country. Activation of the first Army unit to fire the supersonic REDSTONE was announced on March 14, 1956. The Army uses surface-to-surface artillery missile units armed with REDSTONE and other Army missiles to extend and supplement the range and firepower of artillery cannon. These artillery missile units are capable of delivering both atomic and non-atomic projectiles. REDSTONE, named for the place of its development, the Army's Redstone Arsenal at Huntsville, Alabama, is a future operational field missile and at the same time a basic "step" toward the new JUPITER. The

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14-14

REDSTONE was developed under the supervision of Dr. Wernher von Braun, developer of the German V-2 Rocket, and it is being produced by Chrysler Corporation.

JUPITER is the intermediate-range ballistic missile, capable of being launched from land, which the Army Ballistic Missile Agency was set up to develop under high priority early in 1956.

LACROSSE is a highly accurate, field artillery guided missile for use in close tactical support of ground troops. It is an all-weather guided missile capable of carrying highly effective area type warheads and sufficiently accurate for destroying hardpoint targets. It will replace and supplement conventional artillery. It uses a solid propellant rocket motor. The LACROSSE system includes the missile, a launcher mounted on a standard Army truck, and other ground equipment. It was developed by Cornell Aeronautical Laboratory of Buffalo, New York, and it is being produced by Glenn L. Martin Company, Baltimore, Maryland.

DART is a guided anti-tank missile using a solid-propellant rocket. It was designed for an increased effective range, for higher accuracy at this longer range, for greater probability of a first round hit, and for a larger warhead. The DART missile is designed for use by front-line troops. It carries a warhead capable of defeating the heaviest armor known, and delivers this warhead with pinpoint accuracy. It can be launched by a light-weight launcher from a variety of vehicles. The system is being developed under an Army Ordnance contract by Aerophysics Development Corporation.

NIKE-HERCULES will be the nation's second land-based combat-ready surface-to-air guided missile system to be placed by the Army into the air defense system of the United States. The NIKE-HERCULES missile is an integral part of a weapon system which electronically acquires the target and causes the missile to intercept the target. The missile can engage and destroy (at much longer ranges and higher altitudes than NIKE-AJAX) either single, or formations of, aircraft of the present or foreseeable future. The dart-shaped missile alone is 27 feet long; the booster is 14.5 feet long. The missile may be launched by remote control and it is given its initial impetus by a solid propellant booster rocket and then accelerated by a solid sustainer motor. The atomic warhead is designed to insure that detonation can occur only at altitudes sufficiently high to prevent damage to near-by friendly

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terrain. The design, development, and production of the missile system by the Army is the result of extensive, coordinated efforts of the Army Ordnance Corps, Western Electric Company, Bell Telephone Laboratories, and Douglas Aircraft Company, together with numerous subcontractors.

## NAVY

SIDEWINDER, the Navy's new operational air-to-air guided missile named after the desert rattlesnake, provides a rugged, inexpensive weapon capable of operating against high-performance-type aircraft. It can destroy enemy fighters or bombers from sea level to altitudes of over 50,000 feet. Basically a weapon to augment protection of our men and ships at sea from attacks by enemy aircraft, SIDEWINDER also will be employed in air defense of the continental United States. Simplicity of this missile, which has very few moving parts and no more electronic components than an ordinary radio, requires no specialized technical training to handle and assemble it effectively. The requirement for SIDEWINDER was assigned to the Naval Ordnance Test Station of the Bureau of Ordnance at China Lake, California, in 1950, and the missile was developed originally by Dr. W. B. McLean. Several industrial concerns are connected with this program. On October 25, 1956, the Navy announced new contracts, including Air Force requirements, had been awarded for production of guidance and control units to Philco Corporation of Philadelphia, Pennsylvania, for about \$14 million, and to General Electric Company, Utica, New York, for about \$17 million.

PETREL, an air-to-surface weapon, was developed under technical direction of the Bureau of Ordnance by the National Bureau of Standards primarily for use against enemy ships at sea. Launched by patrol aircraft well outside the range of the target's air defense, the missile attacks at high speed, saving the pilot from antiaircraft hazards such as those of World War II. Engineering production phase was coordinated by the Naval Ordnance Experimental Unit, a field activity of the Bureau of Ordnance located at the Bureau of Standards, with the production contractor, Fairchild Engine and Airplane Corporation. PETREL is operational, assigned to a number of patrol-type aircraft and fleet squadrons.

REGULUS, a surface-to-surface missile resembling a conventional swept-wing jet fighter about 30 feet long, was developed by Chance  
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Vought Aircraft Company in 1948 under sponsorship of the Bureau of Aeronautics, and was designed for launching from submarines, surface ships, and shore bases. The launching equipment can be installed in a short period of time on several types of vessels at relatively low cost, with only slight modification to the ship itself. Tactically, it will be used against appropriate land targets for the Marine Corps also. Although the assault missile and certain other configurations will employ a drone version of REGULUS, tactical employment will include also those techniques and guidance systems associated with the operation of all-weather, distantly controlled guided missiles, making it possible to utilize this missile in various ways without the expense and effort of designing and procuring a separate one for each function. On December 12, 1956, Chance Vought's Dallas plant had orders totaling \$26 million for additional production of REGULUS I, the Navy's first operational attack missile, introduced into fleet service in 1955, and REGULUS II, an advanced supersonic missile operational in the fleet, a faster, long-range successor to REGULUS I and usable from the same ships and submarines. The non-recoverable version of REGULUS I is capable of delivering a warhead over a range of hundreds of miles guided by a built-in electronic "brain." The recoverable version, equipped with a retractable landing gear, flies pilotless missions and lands intact to be flown again. As many as 16 flights have been made by a single missile.

TERRIER, a supersonic surface-to-air guided missile, was fired experimentally in November, 1954, from the Navy's oldest battleship, USS MISSISSIPPI, converted into a test ship for this purpose. The missile was successfully demonstrated in the 1954 Operation LANTFLEX. A two-day press demonstration held at Guantanamo Bay, Cuba, included firing of TERRIER from the Navy's first guided missile cruiser, USS BOSTON, on March 13, 1956. A slim, needle-nosed weapon, TERRIER is designed to intercept aircraft at longer range and higher altitudes than conventional anti-aircraft guns, and under all-weather conditions. A contract for approximately \$29 million has been awarded to Convair, a division of General Dynamics Corporation, at Pomona, California, for production of guidance and control units of this missile, announced in December 1956. Convair, the major prime production contractor, participated in the engineering of TERRIER, which was developed for the Bureau of Ordnance under technical direction of the Applied Physics Laboratory, Johns Hopkins University, Silver Spring, Maryland. TERRIER, now in operational use, is the main antiaircraft battery of guided missile cruisers USS BOSTON, USS CANBERRA, the guided missile destroyer USS GYATT, and it will be used in many other destroyer-frigates

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type vessels. The well known "coke handling" system for launching the TERRIER is a product of Northern Ordnance, Inc., Minneapolis.

SPARROW I, a supersonic air-to-air missile operational in the fleet, was developed by the Bureau of Aeronautics, the Naval Air Missile Test Center at Point Mugu, California, and the Sperry Gyroscope Company. Described as a powerful deterrent against attack by jet bombers and fighters, it is about 12 feet long, weighs about 300 pounds, and is powered by a solid propellant rocket motor. Guidance signals deflect the missile's wings and direct it to intercept the target, even under evasive action. The SPARROW I weapons system is versatile, permitting effective attacks against high and low altitude targets flying singly or in groups.

SPARROW II, an experimental missile not intended for fleet use, was developed by Douglas Aircraft Corporation.

SPARROW III, an improvement of the original missile, was developed by the Raytheon Manufacturing Company, Boston, Massachusetts, and it will augment SPARROW I in fleet air defense.

TALOS, a supersonic surface-to-air guided missile for use in air defense of the United States Navy, was developed by the Johns Hopkins University Applied Physics Laboratory, Silver Spring, Maryland, under contract to the Bureau of Ordnance. Bendix Aviation Corporation, prime contractor, has been awarded a contract (announced January 1957) for approximately \$27 million for production of this missile. It will be used aboard USS LITTLE ROCK, USS GALVESTON, and USS OKLAHOMA CITY upon completion of their conversion to guided missile cruisers. In an open press conference aboard USS BOSTON, in Guantanamo Bay, Cuba, in March, 1956, R/Adm. J. H. Sides, USN, said, "TALOS...larger size than TERRIER...longer range...will reach out into zones now covered by interceptors." The missile is being evaluated at White Sands Proving Ground, New Mexico, by naval personnel stationed there.

TARTAR, is a surface-to-air guided missile. In an open press conference on March 13, 1956, aboard the guided missile cruiser USS BOSTON, R/Adm. John H. Sides, answering direct press queries, said: "TARTAR will be small enough to go into destroyers and the secondary batteries of large ships, yet have more performance than the original TERRIER...destroyers are to be designed to carry the missile...it can

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1313

replace five-inch mounts...solid propellant rocket." Adm. A. A. Burke, Chief of Naval Operations, at same conference, said, "TARTAR should be cheaper than TERRIER." Convair, a division of General Dynamics Corporation, at Pomona, California, is under contract for engineering and production to the Bureau of Ordnance. Announcement was made in March, 1957, of contracts awarded for construction of eight guided missile destroyers which will be equipped to launch TARTAR.

POLARIS, the Navy's Intermediate Range Ballistic Missile in the early stages of development, was announced in January, 1957. It will be substituted for JUPITER, a land-launched weapon originally designed by the Army, in the Fleet Ballistic Missile System. The Navy's part in the JUPITER program was essentially to develop a shipboard launching system, and this will be transferred to the POLARIS program. POLARIS is designed specifically for shipboard use within the fleet. The major contractors are: Lockheed Aircraft Company, Sunnyvale, California; Aerojet General Corporation, Sacramento, California; Massachusetts Institute of Technology, Cambridge, Massachusetts; General Electric Corporation, Pittsfield, Massachusetts; Interstate Electronic Corporation, Anaheim, California; and Westinghouse Corporation, Sunnyvale, California.

#### AIR FORCE

MATADOR (TM-61) tactical missile of subsonic speed, is manufactured by Glenn L. Martin Company. It received its first flight in December 1950, and was operational March, 1954. It has a wingspan of 28.7 feet; length of 39.6 feet. Ground-launched by a rocket booster from a roadable launcher, it is powered by an Allison jet engine (J-33-A-37), controlled electronically in flight by ground personnel, and is capable of delivering conventional or nuclear weapons several hundred miles. The MATADOR, presently in operational use in Air Force units, is being replaced by an improved version, designated as MATADOR TM-61C. The new MATADOR will have greater range than its predecessors and contain an improved guidance system. One significant improvement in the TM-61C guidance system is its high resistance to electronic countermeasures. With its increased range, the new MATADOR is capable of deeper penetration into enemy territory, and it can be used over wide expanses of water. Five tactical missile groups now employ the MATADOR, three being assigned to the first Tactical Missile Wing, deployed in Europe. One Unit has been assigned to Taiwan (Formosa). The first MATADOR Missile Group was activated in 1951, and the first unit

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was assigned overseas in March, 1954. Operating at speeds of more than 650 miles-per-hour, the missile is capable of performance at altitudes in excess of 35,000 feet.

FALCON (GAR-1) is a guided aircraft rocket of supersonic speed manufactured by Hughes Aircraft Company. Under development since 1947, it was test fired in 1950. Production was ordered in 1955 and it became operational in March, 1956. FALCON, which weighs slightly over 100 pounds and is approximately six feet long, is powered by solid rocket propellant and electronically fired and guided. Designed for underwing or pod installation, it can be carried in quantity by interceptor aircraft and launched miles from target; it automatically "homes" on target. During test period, it knocked down target planes without carrying explosive warhead. FALCON is now in active units of the Continental Air Defense Command.

SNARK (SM-62), long-range strategic missile, is manufactured by Northrop Aircraft, Inc., and is undergoing tests at the Air Force Missile Test Center, Patrick Air Force Base, Florida. It is a winged pilotless bomber powered by an Allison turbo-jet engine, and is first U.S. long-range missile to be test flown. It is considered to have range, accuracy, and load-carrying capabilities as good as ballistic missile types. The SNARK is in production for assignment to Strategic Air Command units. It has been test flown in the vicinity of 3,000 miles.

NAVAHO (SM-64), long-range strategic missile, manufactured by North American Aviation, Inc., is now undergoing tests at Patrick Air Force Base. Original flight tests were made at Edwards Air Force Base, California. A rocket-launched, air-breathing missile, it is considered to have range, accuracy, and load-carrying capabilities as good as ballistic missile types.

RASCAL (TAM-63), long-range guided missile under development by Bell Aircraft Corporation, is a rocket-powered pilotless bomber designed to be carried by strategic bombers and released miles from objective to proceed at high speed to target.

BOMARC (IM-99), a long-range interceptor guided missile of supersonic speed, is a ground-to-air weapon designed to operate at high altitude; it is now in production by the Boeing Airplane Company. It is launched vertically and cruises on twin ram-jet engines supersonically toward the target, guided by the latest electronic systems available.

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The BOMARC has been successfully tested in a series of firings from Patrick Air Force Base, Florida, against high flying drone aircraft far out over the Atlantic Ocean. The BOMARC's range enables it to destroy enemy planes at a far greater distance than any other missile in the Air Defense Command, to which the BOMARC will be assigned.

INTERCONTINENTAL BALLISTIC MISSILES include the ATLAS and TITAN ICBM. Convair Division of General Dynamics Corporation received a development contract for airframe and airframe components for the ATLAS ICBM. A second development contract for airframe and airframe components for the TITAN ICBM was awarded to Glenn L. Martin Company. Separate contracts were awarded to prime contractors for sub-components such as guidance system, propulsion, and other sub systems. Many of the major components and sub-systems will be identical for the ICBM-IRBM. This factor is expected to accelerate the development and greatly reduce the overall cost of the program.

INTERMEDIATE RANGE BALLISTIC MISSILE THOR IRBM is being developed by Douglas Aircraft Company under a contract awarded in December 1955. Separate contracts were awarded to prime contractors for sub-components such as guidance system, propulsion, and other sub-systems. Many of the major components and sub-systems will be identical for the ICBM-IRBM, which factor is expected to accelerate development and greatly reduce the overall cost of the ICBM-IRBM program.

//Pentagon OPI 0520/

\* \* \*

### 302. MISSILES STOPPED BY CAMERAS OF BALLISTIC LAB:

Design of new missiles and rockets needs free flight observations for obtaining necessary information on principles governing their transonic and supersonic flights. At the Thompson Aeroballistics Lab, Naval Ordnance Test Station at China Lake, Calif., missiles hurtle over an indoor range under the watchful eyes of specially set-up cameras. The scale models at this unusual lab set off an automatic sequence when entering the first light screen at the first camera station.

The images recorded by the ballistics cameras are silhouettes produced by brilliant illumination of a background made of reflective sheeting. Use of the lab as a missile research tool can carry a weapon through all the development stages to a point where it is ready to be mass-produced. Missiles of all types can be tested at the facility.

//Naval Aviation News 05-33/

## MAGAZINE PREVIEWS & REVIEWS

DATA has been making arrangements with other magazines to see page proofs and contents prior to publication so that we may review and point out articles of interest to our readers.

### PREVIEWS

#### MISSILES & ROCKETS (Available June 10, 1957)

June issue is devoted to nuclear powered rockets and ion propulsion with emphasis on space flight. Among the feature articles is one by the dean of ion propulsion, Dr. Ernst Stuhlinger of the Army Ballistic Missile Agency. Other articles are concerned with heat release in atomic rockets, atomic fuels and the sociological aspects of space flight.

#### ORDNANCE (Available July 1, 1957)

Main article by George Fielding Elliot, well known military writer, called "Our All Purpose Navy." Elliot says Navy is our most important peace-time force. It is the only force we can display with full armor and flying our flag where we won't get into international political controversy. Other countries expect naval vessels to visit them; would not welcome Army or Air Force on their soil. One by Maj. Gen. E. P. Mechling, commander of Air Force armament center at Eglin AFB, on the data reduction equipment used to evaluate the flight testing of our guided missiles. Garret Underhill, well known writer on new Soviet weapons, has interesting article on latest USSR ordnance.

#### SIGNAL (Available June 15, 1957)

"Communications in the Nuclear Age," by James E. Dingman, the director of operations for long lines of AT&T. It tells about the procedures that would be followed by AT&T in routing phone lines if all-out nuclear war should come to the U.S. Dan Noble of Motorola, "A Revolution in Electronics" - transistor story.

### REVIEWS

#### CORONET (June 1957)

"The Tortuous Life of the X-2," by Martin Gross, tells of the problems involved in developing and testing the Bell rocket research plane.

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Cook Technological Center, Morton Grove, Illinois



Dr. Leslie W. Ball

Dr. Ball is a leading scientist devoted to reliability efforts and programs, and is a prominent consultant to top management in aircraft and missile industries. His independent evaluation of the "HEPR" Program follows:

## The State of the Art: NEW TOOLS ARE HERE TO UPGRADE RELIABILITY NOW!

### Dr. Leslie W. Ball

In 1940 Winston Churchill stirred the conscience of American industry by his confident plea . . . "Give us the tools and we will finish the job." Our industry did respond magnificently and gave the Allied Armed Forces the tools with which the immediate job of destroying the dictatorships was finished.

But we know only too well that neither in peaceful competition nor in military defence can industry rest upon past achievements. New tasks of staggering magnitude always will arise to challenge the imagination and guts of our industrial management and to challenge the thinking and action abilities of our design, production, test, and quality control engineers.

Today, a new challenge to managers and engineers is stark in its clarity, and voracious in its demand for action. Clearly, the marriage between the science of electronics and the science of systems engineering has been, and will continue to be prolific in the procreation of complex equipments that increase the productivity of peace-time industry and radically improve the potential effectiveness of our military defence. It is evident further that many top managements have seized upon these opportunities.

In those industries that are adopting automation, and throughout our defence program, decisions have been taken to entrust the future to the abilities of complex requirements. In the case of some equipments it is merely the financial future of a single company that has been committed. In the case of military equip-

ment, our future in the world has been committed to the belief that complex weapon systems based on electronic equipment can be made to perform adequately in all respects.

#### DRAMATIC PERFORMANCE

In the first flush of excitement over the potentialities of radically new equipments, the abilities and energies of both managers and engineers usually have been concentrated on obtaining dramatic performance. In multitudes of offices and laboratories throughout the nation, equipment performance abilities worked out on the drawing board or predicted by electronic computers have been received with enthusiasm and adopted as target. As time has brought the conversion of calculations and predictions into actual hardware, it has become painfully evident that the ominous forebodings of a small band of pioneers, now known as "Reliability Engineers," were not without substance.

Much has been written about the fundamental relationships between unreliability and complexity in electronic equipments and about the incompatibility of extracting the last ounce of high performance out of equipments that must be reliable under conditions of high environmental stress and limited maintenance skill. So, today, the managers, upon whose shoulders rests the heavy responsibility for having taken decisions to commit their companies or their defence programs to complex high performance systems, must undertake an agonizing reappraisal of their electronic equipments within these systems.

#### BLUNT QUESTION

The blunt question that faces them is, "Must we retreat to simpler, lower performance devices, or is there an immediate line of reliability upgrading action whose cost is within reason and whose effectiveness is beyond question?"

The answer to this vital question is not to be found in academic discussions of the abstractions of reliability nor in the ivory towers of higher mathematics. It is to be found in the testing and analytical laboratories where countless analyses have been made of equipments that have failed in service or in which failure has been produced by simulation in the laboratory of service stresses.

*The answer to the question "Must we retreat?" is a confident "No, we need not retreat. There is a path to electronic equipment reliability whose cost is within reason and whose effectiveness can be assured."*

To define the path to reliability specifically and clearly, we must first express the underlying causes of equipment unreliability in engineering management terms.

Both technological advances and management action have provided the systems engineers with the tools that they need to work out complex system performance, and to generate sound preliminary designs. Unfortunately, in the electronic industry the detail designer, the production engineer, the test engineer, and the quality control engineer have not been provided with all the tools that they need to follow through from a preliminary system

# State of the Art: NEW TOOLS ARE

design to delivery of a completely reliable finished product.

A FUNDAMENTAL CAUSE OF ELECTRONIC UNRELIABILITY IN TODAY'S ELECTRONIC EQUIPMENT IS THAT DESIGNERS ARE REQUIRED TO DESIGN CIRCUITS, QUALITY CONTROL ENGINEERS ARE REQUIRED TO CONTROL CONFORMANCE, AND TEST ENGINEERS ARE REQUIRED TO PLAN EVALUATION PROGRAMS WITHOUT MUCH OF THE BASIC HANDBOOK TYPE OF DATA ON WHICH THE RELIABILITY OF ALL OTHER TYPES OF ENGINEERING EQUIPMENT DEPENDS.

To illustrate this deficiency, suppose that the management of an aircraft company had made excellent provision to obtain systems engineering and a preliminary design for a new super performance complex rocket-powered plane and then assigned the task of detail design, quality control and test planning to their staff. But, with the provision that they would be denied anything approaching complete knowledge of the strength, endurance and failure characteristics of the materials and components of which the system was to be built.

The opinion of their customer and of other managers would be that this was a preposterous way to manage an engineering project, and unreliability in the product would be a foregone conclusion. *And yet, inadequacy in the organized knowledge of strength, endurance and failure of component parts is characteristic of almost all military and industrial electronic equipment projects.*

Management thinking about the provisions that they must make for providing their staffs with adequate knowledge of electronic component parts can be helped greatly by the following definition: "Any equipment component or part is inherently unreliable until every mode of failure is known, understood, measured and controlled."\*

Throughout the mechanical engineering industries the truth and significance of this definition is accepted as self evident. Moreover, large quantities of organized knowledge on understanding, measurement and control of every mode of failure of mechanical parts are contained in engineering handbooks. For example, in the case of reciprocating machinery unreliability caused by the phenomena of fatigue is no longer tolerated because an understanding of the design and manufacturing factors that can per-

mit fatigue to occur, together with tables and curves showing the relationship between stress level and number of cycles to failure and established quality control procedures, are all available in the form of handbook data.

## URGENT NEED

The problem of the component part failures that cause unreliability in electronic equipment is analogous to fatigue failure in metal parts, but there are at least two important differences, each of which makes the need for handbook data more urgent.

First, the stresses imposed upon the part are more diverse. That is, the effects of placing an electronic component part in a complex circuit require rather more analysis and more types of data than required for the determination of the stresses on a part in a mechanical structure.

Second, the number of modes of failure resulting from variety in the materials and methods of construction of electronic parts are much greater than for purely structural parts that can fail only by such well known phenomena as tensile fracture.

Third, whereas mechanical parts are characterized by long service and laboratory testing histories that have resulted in well organized and widely published handbook data, electronic parts have either not existed long enough or have not been studied intensively enough for such handbook data to be available.

The contrast between disciplines in electronic and mechanical engineering is obvious. In the electronic industry, management and engineers must undertake immediate and imaginative action to generate and distribute handbook type data. This would embrace the understanding, measurement and control of all types of electronic component parts whose failure contributes to unreliability.

We may assume that this statement is beyond question, and the real issue for management and engineers to decide is "WHAT IS THE FASTEST, MOST ECONOMICAL AND MOST EFFICIENT METHOD TO GENERATE HANDBOOK DATA?" The possibility of each company being dependent only on its own component part testing programs must be ruled out, because the cost is prohibitive and the time taken to get the job done on limited testing facilities would be hopelessly excessive.

## IMPORTANT PECULIARITY

In this regard a very important peculiarity of electronic component parts must be recognized. This peculiarity may be called "the existence of minority groups

in the manufactured population." For example, consider a population of one thousand capacitors produced by a particular manufacturer. From the point of view of performance, all these capacitors will belong to a single homogeneous population, but, from the point of view of reliability, the population is by no means homogeneous.

If the thousand capacitors were subjected to circuit stresses and to external environmental stresses, some of them would become "early failures" and others would become "random failures." Suppose that out of the thousand, ten are potentially early failures and another forty are potentially random failures. If a test sample of, say, six capacitors were chosen from among the nine hundred and fifty that will fail by wear out, the results of this test program would be completely useless and dangerously misleading because they would tell nothing of the unreliability that would be caused by the ten early and the forty random failures.

It follows that it is vitally important to subject the whole population of one thousand capacitors to an ambitious test program that includes statistical design of experiments, detailed analysis of failures, and statistical interpretation of results.

Even in equipments where a high failure rate of, say, one part in a thousand can be tolerated, the test sample size should consist of several hundred parts. In equipments where failure rates of only one in a hundred thousand can be tolerated, the sample size and consequently, the cost of the test program must be increased correspondingly.

IT IS THEREFORE APPARENT THAT EVEN LARGE ELECTRONIC EQUIPMENT COMPANIES CANNOT AFFORD TO UNDERTAKE TEST PROGRAMS TO GENERATE ALL THE KNOWLEDGE OF ELECTRONIC COMPONENT PARTS THAT THEY REQUIRE, AND THAT THEY MUST SUPPLEMENT THEIR OWN WORK BY PARTICIPATION IN A PROGRAM SUBSCRIBED TO BY A LARGE GROUP OF COMPANIES.

A second cost aspect is that the recording of test data by technicians reading indicating instruments is incompatible with the enormous number of readings that must be made to generate the amount and accuracy of data required for handbook purposes. Consequently, the principle of automation must be applied to the recording of data during component part testing programs.

Both the above cost considerations lead to the conclusion that electronic equipment manufacturers can reduce the cost of reliability programs radically by sub-

\* "Management Use of Laboratory Testing to Achieve Reliability." A Paper presented to the University of California at Los Angeles Engineering Management Symposium in January 1955 by Leslie W. Ball.

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scription to testing programs performed in a competent laboratory, where sample sizes of thousands can be handled and where data can be recorded automatically.

## STEADY FLOW

The general relationship between such a laboratory and the subscriber to such a program must go far beyond the mere provision of testing facilities and automation instrumentation. The laboratory must provide the subscriber with a *steady flow* of organized knowledge that makes it possible for the subscriber to diffuse throughout his whole organization "knowledge, understanding, measurement and control" of all the modes of failure of the electronic component parts used in the company's products.

While the above statement summarises the service that must be rendered and leaves no doubt that the benefits to be gained by subscription to this laboratory program will far exceed the cost to the subscriber, and while the brochure offered by the "HELP" program provides detailed information to the individual engineer, it is to be expected that the subscriber's management will want a more specific summary of what will come out of the testing program, and of the identity of the departments within his organization that will use the output, and of the ways in which they will use it.

On the basis of work already done in similar, but much more restricted testing programs, the following five specific types of output and six specific types of application by subscriber's personnel may be identified.

## FAILURE RATE CURVE — CIRCUIT STRESS

For each type of component part it is generally recognised that some particular circuit stress is of primary importance in regard to failure rate and reliability. For example, in the case of capacitors, the voltage across the capacitor is accepted as the primary circuit stress. Test programs for each type of part will result in a family of curves in which failure rate is the ordinate, time is the abscissa, and one curve is plotted for each value of the primary circuit stress.

In general, the curves will have a characteristic shape which in many cases will be the familiar three part curve showing early, random and wearout failures. The corresponding time intervals may be called the "infant mortality screening period," "service period" and "over-age period." Quite apart from numerical values of the failure rates, knowledge of the shape of these curves and of the duration of the infant mortality screening, service and over-age periods are vital to intelligent decisions on quality control and preventative maintenance requirements.

## RELIABILITY INDICES

For those component parts that show a "random" failure rate in the service period, a single value for failure rate index may be established. In other cases an average value in the service range may be selected as characteristic of the part. All these values could be prepared in summary tabulated form suitable for use as reliability indices during the precalculation of the reliability to be expected from any new type of electronic equipment.

## FAILURE RATE CURVES — ENVIRONMENTAL STRESS

It is well known that the failure rate produced by a primary circuit stress can be greatly modified by the environment in which the part operates. For example, in the case of capacitors the ambient temperature will have a major effect upon the failure rates produced at any given voltage.

It is recognized further that, when environmental stress becomes severe, entirely new modes of failure not directly related to the circuit stress are produced and that these new modes of failure will have their own characteristic failure rates. The test program should produce curves showing both the modification of circuit stress failure rates with environments, such as temperature of vibration intensity, and other curves showing failure rates produced by the environment in the absence of circuit stress.

## MODE OF FAILURE ANALYSES

If the laboratory's service to the subscriber finished with the production and mathematical analysis of failures, the most constructive and universally applicable reliability upgrading information would be lost. The laboratory service should include detailed disassembly and analysis of the physical, chemical and mechanical modes of failure of each type of component part. The results and interpretation of these analyses will be available to the subscriber and to the manufacturer of the part.

## CORRELATION OF FAILURE RATES WITH DESK ANALYSES

Obviously, test programs must be performed upon component parts bought from particular vendors, and, consequently, test results presented under the above four categories would be specific to each vendor. However, it would be chronically wasteful to limit the output of the test program simply to the products of the vendor supplying test items.

By careful analysis of the design characteristics of the parts, combined with knowledge of the manufacturing processes and quality controls used by the vendor, it is possible to establish extreme-

ly valuable correlations between failure rates and design and manufacturing factors. These correlations are universally applicable to the products of all vendors. The laboratory should seek to establish such correlations and will present the results in the form of technical reports to the subscribers.

## USE OF TEST RESULTS

### BY SUBSCRIBER'S PURCHASING DEPARTMENT

The results of the test programs will be of direct benefit to the purchasing departments in the selection of component part vendors. Even when a particular vendor's parts have not been included in the program, the subscriber's purchasing department would be able to make use of the test results in evaluating the materials and process controls used by the supplier.

### BY SUBSCRIBER'S PRELIMINARY DESIGN DEPARTMENT

Whenever a new system or equipment is offered in a preliminary design proposal, it is a good management practice to require a precalculation of the expected reliability of the equipment if it is to be built from state of the art component parts. Although at this time the exact number of parts and the circuit stresses that will be imposed upon them are unknown, certain assumptions can be made based on similarities between previous equipment and proposed equipment. By combining these assumptions with reliability indices for the component parts, a precalculation can be made.

### BY SUBSCRIBER'S DESIGNERS

During the design phase, decisions must be made on the general degree of part derating and on the amount of money, space and weight that will be allowed for reduction of environmental stresses. The test program would provide specific numerical values to guide both the amount of action needed and to indicate which changes will be most effective.

### BY SUBSCRIBER'S PARTS APPLICATION ENGINEERS

It is well known that the failure rate for a given part depends greatly on the circuit stresses imposed upon it and that, in some cases, circuit stresses that are of little importance to the performance of the equipment are of major importance to its reliability. The test program should provide specific data for identifying the nature and magnitude of circuit stresses that must be considered by the part application engineer in determining the suitability of a particular part for a particular application.

#### BY SUBSCRIBER'S TEST ENGINEERS

Each electronic equipment manufacturer must make use of a great deal of testing in his own plant for both design and quality control purposes. For example, in the case of custom parts, such as special potentiometers, the subscriber must write his own specification and specify his own test methods. The results of the "HELPR" laboratory program would be valuable in indicating which tests are likely to be most effective for a particular type of component, and to give some significance to them when the size of the test sample has to be very small.

#### BY SUBSCRIBER'S QUALITY CONTROL ENGINEERS

It is generally true that the reliability of electronic equipment can be greatly improved by much more widespread use of non-destructive testing methods on the manufacturer's receiving inspection line and by cautious use of what is now called production environmental testing. The "HELPR" laboratory program would pro-

vide clear indications of which types of non-destructive testing can be most effective and information that should be sought by non-destructive methods.

In the case of production environmental testing, if this is done without the guidance of comprehensive knowledge of the shape of the failure rate curves and the duration of the infant mortality period, there is a very real danger that the environments will increase rather than decrease the unreliability of the equipment. However, with the type of information that the central laboratory program would provide, major improvements in reliability from carefully selected and controlled production environmental tests can be confidently expected.

\* \* \*

The net result of all the above outputs from a central laboratory program and the application of these results by the subscribers could be momentous. Whereas, without a major program for generating handbook data on component parts, the electronic industry may have to retreat from the degree of performance and sophistication in designs now going into

production. *With the proposed program, the horizons for the electronic industry become unlimited.*

Certainly in the case of industrial automation, the difference between a record of unreliability and a record of reliability will not only be a major factor in the success or failure of individual companies, but it will be the difference between a vast new surge of growth for the electronic industry as a whole, and a rapid saturation and ensuing stagnation if the market is limited to only those applications that can tolerate unreliability.

In summary, the new branch of the engineering profession that we call reliability engineers have done an outstanding job in recognizing the nature of the problem, in analyzing its causes, and in delineating the path that must be taken to overcome the problem.

*It is now up to the managers and the responsible engineers throughout the electronic industry to decide whether the American Electronic Industry will advance rapidly and lead the world in producing successful complex equipment, or whether we will hesitate and fall upon the hurdle of unreliability.*

## The "HELPR" PROGRAM

WIRE OR WRITE TODAY for the 52-page book, "The Handbook of Electronic Parts Reliability Program"—A Detailed, Systematic Approach. There is no obligation, just ask for the "HELPR" Book. Address:

General Manager,  
**INLAND TESTING LABORATORIES,**  
Cook Technological Center,  
Morton Grove, Illinois



A DIVISION OF COOK ELECTRIC COMPANY  
Chicago, Illinois

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15 June 1957

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### 303. MISSILES - FIRST PHOTOS OF HAWK - Army: White Sands

The HAWK, Army's solid propellant, 16-foot surface-to-air missile for destroying low-flying enemy aircraft is shown above in first flight photo. The HAWK fits on unique three-missile mobile launcher easily towed on highways. Pencil fuselage is only 14 inches in diameter. Army needed HAWK to compliment high-altitude NIKE batteries. USMC will also adopt HAWK. Raytheon is contractor, Andover, Mass.

### 304. AVIONICS - DOD DIRECTIVES - SecDef

New Department of Defense directives cut \$500 million from the Armed Forces budget on aircraft and missiles during June. As about 75 percent of missile costs are in electronic components, avionics contractors are hardest hit. Sub-contractors suffer most as primes tighten up and begin making more of own sub-assemblies to conserve. DOD Directive 7200.4 of 21 May 1957 (reproduced in full in June 1 DATA) requires a service to have adequate appropriations in reserve to complete procurements before they let initial contracts. Strong editorial comments in Electronic Week and Electronic News condemn Wilson orders, say electronics producers will lose \$375 million during June alone.

### 305. MATERIALS - CERAMICS - BuShips

June issue of Navy's Bureau of Ships Journal has interesting article on use of ceramics for high-performance machine tools, implies transition in Navy tools may be underway. Advantages of ceramics: Bending strength and impact strength of oxide-base ceramics compare favorably with carbides. Steel finishing at speeds ranging from 300 to 7500 surface feet per minute and machining of steel with Brinell readings up to 300 are claimed possible with oxide ceramics.

306. CONSTRUCTION - CAPEHART HOUSING - Army Info. Digest

**- TITLE VIII (CAPEHART) HOUSING APPROVED FOR CONSTRUCTION (AS OF 26 APRIL 1957)**

TITLE VIII (ARMY) REPORTING TO THE ARMY		TITLE VIII (ARMY) REPORTING TO THE ARMY		TITLE VIII (ARMY) REPORTING TO THE ARMY		TITLE VIII (ARMY) REPORTING TO THE ARMY		
Installation	Units	Installation	Units	Installation	Units	Installation	Units	
ALABAMA	300 (100)*	Fort McClellan	Granite City Engineer	ILLINOIS	Fort Crowder	MISSOURI	TEXAS	
	670 (270)*	Redstone Arsenal	Depot	65	Barracks	Disciplinary	Fort Bliss	
	500*	Fort Rucker	Fort Sheridan	150	Fort Leonard Wood	45	Killeen Base	
ARIZONA		KANSAS		NEW JERSEY		MEDICAL CENTER		
Fort Huachuca	575*	Fort Leavenworth	300 (100)*	Fort Dix	702	Fort Hood	400	
Yuma Test Station	200	Fort Riley	455	For Hancock	50	McAllen Base	125*	
ARKANSAS		KENTUCKY		Fort Monmouth		Medina Base		
Fort Chaffee	215	Fort Knox	2,042*	NEW JERSEY		Beaumont Army Hospital	125	
Pine Bluff Arsenal	54*	LOUISIANA		Fort Dix	702	Fort Bliss	400	
CALIFORNIA		Fort Polk	2,000	For Hancock	50	Dugway Proving Ground	100	
Benicia Arsenal	15	Bonner Base	200	NEW JERSEY		Fort Bliss	400	
Camp Irwin	173	MARYLAND		Fort Monmouth	340 (120)*	Dugway Proving Ground	100	
Fort Ord	1,060 (186)*	Fort Detrick	63	NEW MEXICO		Fort Bliss	400	
Two Rock Ranch	33	Fort Meade	1,000	White Sands Proving	209	Dugway Proving Ground	100	
COLORADO		D/A Receiver Station	NEW MEXICO		Ground	Fort Bliss	400	
Fort Carson	500*	(LaPlata)	12*	Wingate Ordnance Depot	8	Dugway Proving Ground	100	
Pueblo Ordnance Depot	20	Fort Ritchie	70	NEW YORK		Fort Bliss	400	
Rocky Mountain Arsenal	20	MASSACHUSETTS		Fort Jay	218	Dugway Proving Ground	100	
GEORGIA		Fort Banks	26	Fort Tilden	46	Fort Bliss	400	
Fort Benning	1,000*	Fort Devens	450	Fort Totten	72	Dugway Proving Ground	100	
Fort Gordon	400	Natick Quartermaster Re-	NEW YORK		Fort Wadsworth	120	Fort Bliss	400
Fort McPherson	107	search and Engineering	50	WINGATE ORDNANCE DEPOT	8	Dugway Proving Ground	100	
Fort Stewart	388*	Center	50	NEW YORK		Fort Bliss	400	
MICHIGAN		NEW YORK		Charleston Transportation	1,500*	Dugway Proving Ground	100	
Camp Lucas	73	Fort Jackson	12	Depot	1,500*	Fort Bliss	400	
MISSOURI		NEW YORK		Philadelphia Quartermaster	91	Dugway Proving Ground	100	
PENNSYLVANIA		NEW YORK		Depot	46	Fort Bliss	400	
RHODE ISLAND		NEW YORK		Philadelphia Quartermaster	91	Dugway Proving Ground	100	
SOUTH CAROLINA		NEW YORK		Charleston Transportation	12	Fort Bliss	400	
TEXAS		NEW YORK		Depot	300	Dugway Proving Ground	100	
UTAH		NEW YORK		Philadelphia Quartermaster	91	Fort Bliss	400	
VIRGINIA		NEW YORK		Charleston Transportation	12	Dugway Proving Ground	100	
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307. The Army during past two years has provided more housing than in all previous years combined, throughout its entire history.

So says feature story in Army Information Digest, official magazine of the Department of the Army, in coming July issue. Using Military Construction, Army (MCA) funds which are appropriated for this specific purpose by Congress, contracts are let by competitive bid principally on Government-owned land. Currently, however, only minimum number of family units are being built with MCA funds. Big money now comes from National Housing Act with Title VIII (Capehart) amendment. Units are built to mortgage for \$16,500 or less. List above, prepared by Army Information Digest, shows under construction and proposed Capehart housing for Army. Navy and Air Force have similar plans.

## 308. PRESIDENTIAL ASSISTANT CHANGE - White House

Special Assistant to the President for Aviation, Maj. Gen. E. P. Curtis (Ret.), retires from White House service effective 15 June. He will return to Eastman Kodak as vice president in charge of international sales. Curtis will be replaced at White House by Maj. Gen. Elwood R. Quesada (Ret.).

**DATA REQUEST - FILL IN COMMENT CARD - Ed.**

We would very much like to know more about what you like or do not like in DATA. In this issue of the DATAGRAM we have provided you with a postage-free comment card and would be very appreciative if you would take a minute to fill it in and place it in your outgoing mail.

Need a special type of information? What else would you like to see in DATA? Write us NOW and if the information is available, you'll see it in DATA.



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